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THE RELATIONSHIP BETWEEN CAMEL AND TAIWANESE BANKS PERFORMANCE: SBM NETWORK DEA APPROACH

The purpose of this paper is to investigate the relationship between CAMEL (Capital Adequacy, Asset Quality, Management, Earnings, Liquidity) and bank performance to advise managers to pay more attention to CAMEL to enhance competitiveness of banks. The results show that high profit efficiency was achieved despite bank capital not being properly and flexibly utilized. Overall, maintaining the liquidity of capital without reducing profitability is a challenge that defines the ability of banks to manage their operating capital. Potential applications and strengths of DEA (data envelopment analysis) in assessing financial organizations are highlighted.
Keywords: *banks; DEA; CAMEL; profit efficiency.*

Фу-Чіань Чен

ВЗАЄМОЗВ'ЯЗОК МІЖ CAMEL ТА ІНШИМИ ПОКАЗНИКАМИ РОБОТИ ТАЙВАНЬСЬКИХ БАНКІВ: МЕРЕЖЕВИЙ АНАЛІЗ SBM DEA

У статті досліджено взаємозв'язок між CAMEL та іншими показниками роботи банків, продемонстровано важливість індикаторів CAMEL у підвищенні конкурентоспроможності банку. Результати аналізу даних демонструють, що рентабельність може бути досягнута навіть при невірному використанні капіталу банку. Загалом, підтримка рівня ліквідності капіталу без зниження його прибутковості є суттєвим показником здатності банку керувати операційним капіталом. Продемонстровано способи застосування DEA та переваги даного методу аналізу для фінансових організацій.
Ключові слова: *банки; DEA; CAMEL; рентабельність.*
Рис. 1. Табл. 4. Літ. 28.

Фу-Чиань Чен

ВЗАИМОСВЯЗЬ МЕЖДУ CAMEL И ДРУГИМИ ПОКАЗАТЕЛЯМИ РАБОТЫ ТАЙВАНЬСКИХ БАНКОВ: СЕТЕВОЙ АНАЛИЗ SBM DEA

В статье исследовано взаимосвязь между CAMEL и другими показателями работы банков, показана важность индикаторов CAMEL в повышении конкурентоспособности банка. Результаты анализа данных показывают, что рентабельность может быть достигнута даже при неправильном использовании капитала банка. В целом, поддержка уровня ликвидности капитала без снижения его прибыльности является значимым показателем способности банка управлять операционным капиталом. Продемонстрированы способы применения DEA и преимущества данного метода анализа для финансовых организаций.
Ключевые слова: *банки; DEA; CAMEL; рентабельность.*

1. Introduction

Under the impact of financial liberalization and internationalization, business environment in banking has undergone constant changes and reforms. Since Taiwan implemented the new bank establishment policies in 1991, the number of new banking locations has substantially increased. Although this dramatic increase eliminated the oligopolistic hold of Taiwanese banks, it also resulted in the overabundance of banks, thereby considerably increasing market competition. The opening up of financial markets facilitated competition among banks and increased economic efficiency;

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however, the increased number of banks reduced the interest margin of deposits, increased the ratio of overdue loans, and deteriorated the financial asset quality.

After Taiwan joined the World Trade Organization (WTO) in 2002, foreign financial operators invested large amounts of capital, abundant national financial experiences, and diversified financial products in Taiwan's financial market, which accelerated the establishment of operating sites in Taiwan for foreign financial institutions and consequently decreased the survival rate of Taiwanese financial firms. In 2010, Taiwan and China signed the Memorandum of Understanding (MOU) and the Economic Cooperation Framework Agreement (ECFA), which may significantly influence cross-strait financial industries, causing Taiwanese banking industry to encounter survival problems. The key to sustaining operations of Taiwanese banking industry is determining whether operating efficiency is accurately evaluated. Thus, the primary focus of this study is to properly assess the operating efficiency of Taiwanese banks and provide directions and strategies for improving business performance.

Methods of evaluating bank operating efficiency include the following: financial ratio analysis, parametric approach, and non-parametric approach. The financial ratio analysis uses the financial ratio calculated from the bank's financial statements for analysis. This method is applicable for solving single input and single output problems, but entails numerous evaluation indicators, which hinder the efficiency assessment of different units. In addition, weight values can be influenced by subjective perceptions, thereby distorting the results (Megginson, Nash, Matthias, 1994).

The parametric approach primarily consists of stochastic frontier approach and is applicable when both input and output possess uncertain factors. However, for this approach, function types must be predetermined, leading to a lack of persuasive power and the necessity for simultaneous statistical tests (Banker, Maindiratla, 1988). The non-parametric approach primarily involves data envelopment analysis (DEA). Because this method is not limited by set function types and large sample numbers, it is applicable for solving multiple input and output problems (Charnes, Cooper, Rhode, 1978).

Traditional DEA neglects the link between economic activities within an organization, and thus cannot express the management message during economic activities. To overcome the mentioned problem, this study employed a network DEA performance measurement model (Tone & Tsutsui, 2009) as a performance evaluation tool for Taiwanese banking industry. It is designed to measure the effects of external environmental factors on organizational operating efficiency.

CAMEL is a set of integrated rating system with standardized and systematized indicators. This system is currently used by the US government's Federal Deposit Insurance Corporation (FDIC) for assessing business management and credit status of commercial banks and other financial institutions. The 5 assessment indicators include capital adequacy, asset quality, management, earnings, and liquidity. The first letter of these indicators forms the acronym CAMEL, which encompasses the following characteristics: it integrates individual ratings with the overall rating and combines qualitative and quantitative analyses as an orientation to assess risk management capabilities. CAMEL fully considers the bank's scale, complexity, and risk level, and is the most effective and basic analysis model for analyzing whether bank's oper-

ations are healthy. Therefore, this study utilizes the Tobit regression to explore the effects of CAMEL indicators on efficiency value.

The remainder of this study is organized as follows: Section 2 is the literature review; Section 3 describes the research design; Section 4 presents the empirical analysis; and Section 5 presents the conclusions.

2. Literature review

Various empirical studies have used the DEA methodology to discuss bank performance. Sherman and Gold (1985) applied the CCR model of DEA and selected input and output variables using a production method to evaluate the operating efficiency in 1980 of 14 branches of a certain savings bank in the United States. The results indicated that DEA was beneficial for determining business efficiency of bank branches. Aly, Grabowski, Pasurka, and Rangan (1990) utilized the BCC model of the DEA to analyze the efficiency of 322 American banks that were present in 1986 and indicated that the low TE resulted from resource waste, rather than the adoption of inefficient scales.

Oral and Yolalan (1990) applied DEA to evaluate the operating efficiency of 20 commercial banks in Turkey and re-allocated resources of branch offices. Yue (1992) analyzed the changes in efficiency performance of 60 commercial banks in Missouri (USA) between 1984 and 1990 by employing the CCR model analysis in DEA and the sensitivity analysis using the window analysis. Yeh (1996) used 6 old Taiwanese banks that existed before deregulation between 1981 and 1989 as research subjects, investigating the relationship between traditional financial ratio analysis and DEA, which was used for banking industry evaluation, to test whether a significant correlation exists between financial ratio factors and DEA efficiency values.

Miller and Noulas (1996) evaluated 201 large banks with the assets exceeding 1 bln USD in 1984 and found that larger banks with better profitability had lower PTE. Chen and Yeh (2000) employed the DEA to evaluate the efficiency of 34 Taiwanese banks between 1995 and 1996. The results showed that the TE of public banks was lower than that of private banks because public banks had higher PTE inefficiency. Saha and Ravisankar (2000) adopted the DEA to analyze the efficiency of 25 Indian commercial banks after financial reorganization and indicated that the efficiency of most Indian commercial banks increased after reorganization. By employing DEA to evaluate the efficiency of 29 banks in Australia during 1996, Sathye (2001) found that the operating efficiency of local Australian banks were higher than that of foreign banks. Moreover, among the source of inefficiency, TE inefficiency was greater than AE inefficiency.

Paradi and Schaffnit (2004) used DEA to evaluate the operating efficiency of Canadian bank branches. The evaluation results provided various branch managers with indications of whether resources were efficiently employed. Chen et al. (2005) studied the performance of Taiwanese banks before and after the implementation of the Financial Holding Company Act. The results showed that financial holding banks had an advantage in management, which allowed these banks to possess higher efficiency than non-financial holding banks.

Bonin et al. (2005) assessed the operating efficiency of 11 transitional Eastern European banks and found that private banks had higher operating efficiency than public banks, and the cost efficiency performance of foreign banks were superior to

that of local banks. Sturm and Williams (2004) and Havrylchyk (2006) reported that foreign banks were more efficient than domestic banks; David (2010) used the CCR model, profit efficiency model and non-oriented slacks-based approach in investigating a bank's security and soundness, and indicated that the non-oriented slacks-based approach obtained the most effective results.

3. Research design

3.1. Establishing bank production procedure. Perhaps the most important step in using the DEA to examine the relative efficiency of any type of firm is the selection of appropriate inputs and outputs. This is partially true for banks because there is considerable disagreement over appropriate inputs and outputs for banks. Scholars have not been able to reach a consensus regarding the definition for a bank input and output. The definitions were established based on the production approach, intermediation approach, asset approach, and income approach. According to the production approach, banks are the institutions that utilize labor, capital, and equipment to produce products that provide various savings accounts and financial services.

These banks regard the number of financial services, transactions, and accounts as bank output, and labor, capital, and operating costs as bank input. Scholars who have adopted the production approach include Sherman and Gold (1985), Ferrier and Lovell (1990), and Oral et al. (1992). According to the intermediation approach, the primary function of banks is to provide financial intermediation services. In other words, banks are the intermediaries that convert financial resources for capital suppliers and beneficiaries to earn profits. The input includes capital, labor, operating costs, and interests, and the output includes lending and investment amounts. This approach was used and preferred by most scholars, including Yue (1992) and Chen and Yeh (2000).

The followers of the asset approach believe that the characteristics of a balance sheet should be adopted to distinguish between bank input and output (Yue, 1992; Chen, Yeh, 2000). For example, lending and investment are bank assets that possess output characteristics, whereas deposits and borrowings are bank debts exhibiting input characteristics. This approach was adopted by Miller and Noulas (1996). Based on the output concept, the income approach regards any item that contributes to bank income as an output. For example, Elyasiani and Mehdian (1990) considered lending and investment returns as an output.

Banks are financial service businesses that demonstrate multiple input and output characteristics; thus, the adoption of the multiple input and output evaluation in DEA is favorable for analyzing banks. In addition, the network DEA model proposed by Tone and Tsutsui (2009) was adopted to evaluate the operating efficiency of local banks in Taiwan. After referencing related studies and considering bank characteristics, a bank profit production procedure was developed. In contrast to the two-stage process established by Seiford and Zhu (1999), this procedure entails the analysis of operating efficiency and profit efficiency, which focuses on internal operations and the process of earning profits.

Input and output items for operating efficiency are based on those defined by the intermediation approach. Input items included employees, fixed assets, and financial costs, and output items consisted of deposits (Siems, 1992; Sathye, 2001), loans and investments. The input items for profit efficiency included loans and investments,

and output items consisted of interest income, non-interest income and income before tax. Figure 1 shows the characteristics of the bank profit production procedure, and Table 1 shows the definitions of input and output variables.

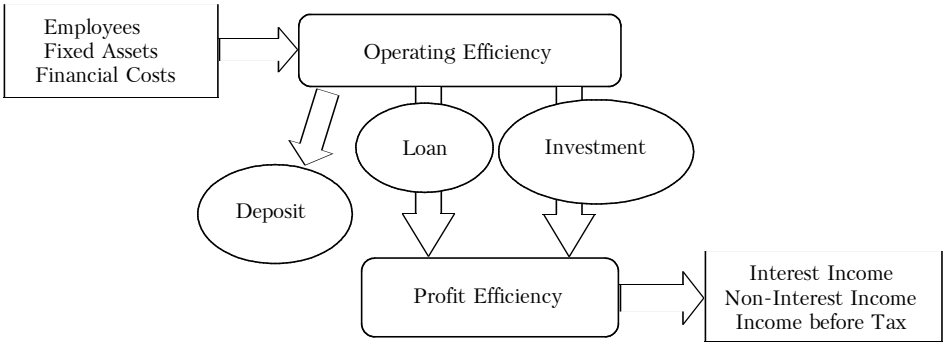

Figure 1. **Bank profit production process,** *designed by the author*

Table 1. **Input and output definitions,** *designed by the author*

Items	Definition	Unit
Employees	Total number of people employed by a bank	People
Fixed Assets	Total fixed assets used by a bank	NT$ 1000
Financial Costs	Include the interest expenditure of funding elements used by a bank	NT$ 1000
Loans	Include total lending of a bank	NT$ 1000
Investments	Include total long - and short-term investments of a bank	NT$ 1000
Deposits	Include total savings of a bank	NT$ 1000
Interest income	Includes revenue from various bank lending and investments	NT$ 1000
Non-interest income	Other business revenue excluding interest and investment revenues	NT$ 1000
Income before tax	Profit before income tax	NT$ 1000

3.2. SBM Network DEA. Traditional network DEA models use a radial measure to evaluate the relative efficiency for each organization in a multistage production process. Radial models may lack objectivity in terms of reflecting the real input/output conditions for each organization, and stand on the assumption that inputs or outputs undergo proportional changes. As in the multistage production process used in this study, it is hard to assign input/output-oriented models without being subjective. In other words, non-radial measures, instead of radial measures that deal directly with input excesses and output shortfalls and do not change proportionally, should be the main concern when seeking to achieve more realistic results. To overcome the shortcomings discussed above, this study utilizes a slacks-based network data envelopment analysis (Tone and Tsutsui, 2009), called network SBM, with internal linking activities in a single implementation, to evaluate operating and profit efficiencies of banks.

3.3. Descriptive statistics. The data were extracted from the Taiwan Economy Journal (TEJ) database in 2010. The study selected 27 listed Taiwanese banks, and each bank is treated as a decision-making unit (DMU) in the DEA analysis. The study examined the efficiency of banks with the two-stage network DEA. The result

shows that input and output variables in the operating and profit efficiency stages in this study have a positive correlation and conformed to unidirectional requirements. There are 3 inputs and 3 outputs in stage one, with 2 inputs and 3 outputs at stage two. Each stage meets the criterion, i.e., $27 > 2(3+3)$ at the first stage and $27 > 2(2+3)$ at the second stage. The DEA model of this study is thus deemed valid.

4. Empirical results

4.1. Measuring operating and profit performances. All efficiency scores are presented in Table 2. The score of relative efficiency ranges from 0 to 1. A bank with the score of 1 is relatively efficient; otherwise, a bank with the score of less than 1 is relatively inefficient. Regarding the operating efficiency of banks, the overall efficiency and the efficiency of various stages of CDIBANK, MEGABANK, CTCB, TCB, and BOFT render these banks as the paradigm for other banks. These 5 banks, compared to other banks, fully use their human resources, operating assets and financial costs, creating relative lending, investment, and deposit amounts, which are subsequently converted into a capacity for earning profits. Subsequently, operating efficiency and profit efficiency were analyzed to further understand the internal performance of banks in profit earning. Table 2 shows that the mean scores of operating efficiency and profit efficiency are 0.748 and 0.528, respectively, indicating that 74% and 81% of the banks can still be improved.

Table 2. **Two-stage efficiency scores for the banks**

DMU	Stage efficiency scores		Overall Efficiency*
	Operating Efficiency	Profit Efficiency	
CHB	0.562	0.558	0.560
FIRSTBANK	0.653	0.538	0.595
HNCB	0.567	0.558	0.563
CDIBANK	1.000	1.000	1.000
MEGABANK	1.000	1.000	1.000
SCBTL	0.692	0.553	0.622
TNB	0.867	0.219	0.543
TCBBANK	0.789	0.172	0.480
CTCB	1.000	1.000	1.000
CATHAYBK	0.989	0.611	0.800
FUBON	0.755	0.693	0.724
TBB	0.607	0.252	0.429
BOK	1.000	0.239	0.620
CSMB	0.280	0.001	0.140
UBOT	0.421	0.192	0.306
SINOPAC	0.822	0.361	0.591
ESB	0.621	0.428	0.525
YUANTABANK	1.000	0.725	0.862
TAISHINBANK	0.460	0.786	0.623
FEIB	0.796	0.602	0.699
TC Bank	0.631	0.298	0.464
ENTIE Bank	0.812	0.626	0.719
SHIN KONG BANK	0.588	0.257	0.423
IBT	0.620	0.466	0.543
JIHSUNBANK	0.659	0.119	0.389
TCB	1.000	1.000	1.000
BOFT	1.000	1.000	1.000
Average Efficiency Value	0.748	0.528	0.638

Note: Overall Efficiency*=0.5 Operating Efficiency +0.5 Profit Efficiency.

The finding indicates that in the area of operating efficiency there are larger differences in relative efficiencies of carriers than there are in their profit efficiencies. This result suggests that policy-makers in these banks should focus first on improving business strategies and then proceed to improving their interest revenue and non-interest revenue.

To determine whether differences exist in various operating characteristics, including operating-type (either financial holding banks or non-financial holding banks), management-type (either government-owned banks[2] or private banks) and scale-type (either larger banks, or smaller banks) for operating and profit efficiencies, a non-parametric statistical analysis is used (Brockett, Golany, 1996) for unknown distribution scores. Variance testing results are shown in Table 3.

Table 3. **Non-parametric statistical analysis of banks**

Characteristics		Number	Mean	Mann-Whitney test (p-value)
Part 1: Operating Efficiency				
Operating type	Financial holding bank (Mean)	14	0.767	0.769
	Non-financial holding bank (Mean)	13	0.727	
Management Type	Government-owned bank (Mean)	8	0.799	0.556
	Private bank (Mean)	19	0.726	
Bank Scale	Larger (Mean)	13	0.748	0.769
	Smaller (Mean)	14	0.747	
Part 2: Profit Efficiency				
Operating type	Financial holding bank (Mean)	14	0.610	0.125
	Non-financial holding bank (Mean)	13	0.439	
Management Type	Pan-public-owned bank (Mean)	8	0.643	0.287
	Private bank (Mean)	19	0.479	
Bank scale	Larger (Mean)	13	0.641	0.058*
	Smaller (Mean)	14	0.422	

Note: * Statistically significant at the 0.10 levels.

From the operating-type perspective, financial holding banks of operating efficiency and profit efficiency were 0.767 and 0.610, respectively, higher than non-financial holding with 0.727 and 0.439. Furthermore, for management-type aspect, government-owned banks have operating efficiency and profit efficiency of 0.799 and 0.643, respectively, higher than private banks with 0.726 and 0.479; for the final scale-type aspect, larger banks have operating efficiency and profit efficiency of 0.748 and 0.641 respectively, which is higher than smaller banks with 0.747 and 0.422. The 3 types of operating characteristics are quite different in profit efficiency. In addition, the scale-type profit efficiency shows a significant difference at the 10% level while the result of the Mann-Whitney test shows no significant difference at the 10% level.

Based on the above results, this study argues that financial holding banks can expand their financial scales by incorporating capital and resources of financial groups. Government-owned banks have evolved from public banks and possess greater advantages regarding deposits, lending and investment compared to non-financial holding banks and private banks. Therefore, interests and non-interest profits of government-owned banks are significantly higher than those of non-financial holding banks and private banks. Thus, operating efficiency and profit efficiency of financial holding banks, government-owned banks, and larger banks are considerably higher.

[2] Banks with 20% or more government shares.

4.2. The relationship between CAMEL and performance. CAMEL has been used by the Federal Deposit Insurance Corporation and other previous studies to assess banks performance (Otchere, Chan, 2003). The capital adequacy reflects the overall financial condition of banks and also the ability of management to meet the need for additional capital. A higher ratio reflects that a bank has higher capacity to absorb unanticipated capital losses.

Asset quality reflects the quantity of existing and potential credit risks associated with loan and investment portfolios, other real estate owned assets, as well as off balance sheet transactions. Management quality is treated as the most qualitative aspect and is subjectively assigned by supervisors based on their judgment of bank management systems, compliance, and prudential practices. Lower ratios reflect higher management quality. Earnings reflect the growth capacity and the financial health of a bank. High earnings signify high growth prospects and low risk exposure and smooth operations. Liquidity implies the cash position of a bank and its ability to meet its customers' day-to-day cash needs and to respond to sudden cash withdrawals.

Barr et al. (2002) showed that banks with strong CAMEL rating have significantly and consistently higher efficiency scores than the banks with weak rating. Wang et al. (2011) presented that banks that appear to have a better financial ratio performance in the 5 perspectives of CAMEL form the efficiency frontier. It implies that CAMEL financial ratios and non-parametric techniques can be used side by side for bank performance evaluation.

To explore the relationship between CAMEL and operating efficiency and profit efficiency, the obtained efficiency scores were regressed against these 10 explanatory variables including capital adequacy ratio, equity to assets ratio, NPL ratio, allowance for doubtful, cost-to-income ratio, expense ratio, ROA, net interest margin, liquid assets ratio, and cash-to-deposit. The regression results are shown in Table 4.

Based on Mode l, the regression coefficients of CAR and CD were 0.0445 and 0.9241 respectively, demonstrating a positive correlation with the significance level higher than 0.10. Higher CAR and CD indicated higher bank operation stability and operating efficiency. This corresponded to general expectations. In addition, the regression coefficients for CI, ER, and ROA were -0.0148, -0.3592, -0.2181, respectively, showing a negative correlation with the significance level that is higher than 0.10. Higher CI and ER signified higher bank operating costs, which negatively influences operating efficiency. This also corresponded to general expectations. However, ROA differed from general expectations, which reflects the circumstance in which banks neglect operating efficiency when attempting to expand their operations and business items to create higher ROA.

According to Mode 2, the regression coefficient for CAR was 0.0833, which shows a positive correlation with the significance level of 0.05. This result corresponded to general expectations. Higher CAR indicates higher bank operation stability and profit efficiency. Moreover, the regression coefficients for EAR, CI, and LR were -0.0324, -0.0217, -0.0473 respectively, exhibiting a negative correlation with the significance level above 0.10. Complying with general expectations, higher CI reduced profit efficiency, and higher EAR and LR reduced profit efficiency. This shows that high profit efficiency was achieved despite bank capital not being properly and flexibly used.

Table 4. **Results of truncated regression by using the heteroskedasticity-robust standard error**

Variable	Model 1	Model 2
	Operating Efficiency	Profit Efficiency
Intercept	-0.0635	0.0121
Capital Adequacy Ratio	0.0445*	0.0833**
Equity to Assets ratio	0.0053	-0.0324**
Non-performing loans	0.1144	-0.0099
Allowance for doubtful credits	0.1100	0.1752
Cost-to-income ratio	-0.0148**	-0.0217***
Expense ratio	-0.3592***	-0.1383
ROA	-0.2181*	0.0073
Net interest margin	0.0833	-0.1361
Liquid assets ratio	-0.0088	-0.0473**
Cash-to-Deposit ratio	0.9241**	0.2019
R-squared	0.5570	0.6420
Adjusted R-squared	0.2322	0.3794

Notes: *,**and ***,indicates those that are statistically significant at the 10%, 5% and 1% levels, respectively.

5. Conclusions

The average operating efficiency and profit efficiency of local listed and over-the-counter (OTC) banks in Taiwan were 0.748 and 0.528, respectively. Furthermore, banks should endeavor to improve their operating efficiency which is at 74% and profit efficiency which is at 81%. These banks can adopt CDIBANK, MEGABANK, CTCB, TCB, and BOFT as their models. In contrast to other banks, these 5 banks can efficiently use their human resources, operating assets and financial costs to create lending, investment, and deposit amounts for enhancing their profitability. Financial holding banks, government-owned banks, and large banks possess advantages in operating efficiency and profit efficiency, compared to non-financial holding banks, private banks, and small banks. Regarding the relationship between CAMEL and operating efficiency and profit efficiency, higher operating stability positively influences operating efficiency, but higher operating costs negatively affect operating efficiency. Overall, maintaining the liquidity of capital without reducing profitability is a challenge that defines the ability of banks to manage their operating capital.

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